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LOWERING GROUND WATER LEVELS¹

BY CLARENCE L. KIRK

What the speaker has to say may not interest any one particularly unless he is engaged in laying pipe in a locality where the soil and subsoil are such as are found at the south end of Lake Michigan in Indiana, where there is nothing but sand. Several years ago, before the district there was very well seweried, the ground water stayed at just about the average surface elevation of the ground and it was very difficult to lay water mains. The sand with the water standing in its pores was a quicksand, about the worst quicksand imaginable. If the water could be taken out of the sand, the trenches would stand fairly well and little difficulty was experienced in the work.

A few years ago, when the speaker was actively in charge of the East Chicago plant, a little trench-draining apparatus with an ordinary diaphragm pump was devised. A 4-inch header about 19 feet long, with $\frac{3}{4}$ inch taps in it, was laid on timbers in the center of the trench, with well points connected to it in a staggered fashion. This header was connected to the pump and the water pumped out of the ground as in any permanent driven well installation.

Recently the man in active charge there has made quite an improvement. The apparatus that he uses consists of a header line about 100 feet in length, in which he uses, say, 30 feet of 3-inch pipe, 30 feet of 2-inch pipe and 40 feet of $1\frac{1}{2}$ -inch pipe. This is made up with reducing flanges where the change in size of pipe comes, and the men handle it one section at a time, if necessary, in moving. The far end of the header line is capped or plugged. On one side of this header and every 5 feet apart a 1-inch tap is made, screwing into this tap a nipple of 1-inch pipe threaded on one end and leaving the outer end so that it can be dressed down with a slight taper. This nipple need be only 5 or 6 inches long. The header is placed on the bank at one side of the trench. A 30-inch well-point $1\frac{1}{4}$

¹ An informal statement at the Richmond Convention, May 10, 1917.

inches in diameter is used, and to it is attached a 6-foot piece of $1\frac{1}{4}$ -inch pipe. This is reduced to 1 inch for a hose connection, which is made permanent, the hose being about 4 feet long. After the trench has been dug as deep as possible without removing the water, the well points are jetted down by means of a piece of garden hose and a straight piece of $\frac{1}{2}$ or $\frac{3}{4}$ -inch pipe, using the regular pump for this purpose and water from a supply tank. After the points have been driven they are connected to the header by slipping the hose over the ferrule-like nipples. A 4-inch triplex pump connected to the header will produce a dry ditch in a short time and by having the outfit connected in this way it leaves full working space in the trench.

Frequent driving has a tendency to spoil the points. The mains are laid with about 5 feet of cover and the banks of sand will stand up without any sheathing at that depth. One of the peculiarities of the sand of that region is that before it has been disturbed in any way trenches cut in it will stand up well, but after it has been once disturbed and its original state changed, it will cave badly.

DISCUSSION

WILLIAM W. BRUSH: On Long Island the Bureau of Water is drawing many millions of gallons of water from sand which is quicksand in appearance and action when saturated, but will stand up when dry. In Manhattan the subway contractors have generally adopted the sump method of draining wet trenches and those who have tried the well method have given it up. The speaker asked some of them why they did not use the latter method and was told that the sump method was much cheaper and gave entire satisfaction. The speaker has seen sand on Williams Street, New York, adjacent to buildings with very heavy foundation loads and where the sand with water in it was like quicksand, drained by putting in sumps surprisingly far apart and carrying these sumps down about 6 feet below the bottom of the subgrade of the subway. The question has therefore arisen in the speaker's mind whether the sump method of draining trenches in wet sand may not be better than the well method, although he has found the latter very satisfactory. In his experience, it has been impracticable to hold foundation planking in place in such soils without some method of draining the water out of the sand.

A. PRESCOTT FOLWELL: The speaker would not encourage anybody from trying any promising method of keeping water out of trenches but he is unable to subscribe to the statement that the well method will be successful in any soil whatever, for he has seen trench work in porous gravel where the contractor was compelled to use a 6-inch and an 8-inch steam pump, working simultaneously, to keep the water down in a trench only 50 to 75 feet long for a sufficient time to permit laying sewer pipe. The speaker doubts that any number of well points would remove enough water from such a trench to keep it dry.

DABNEY H. MAURY: In a paper presented some time ago the speaker attempted to describe some of his engineering mistakes and one of those which had proved most costly was an attempt to put down a well by pumping from the inside. The devices described by the first speaker all aim at the same sensible treatment of the problem, namely, to remove the water without offering the sand an opportunity to flow into the excavation, for if the water is allowed to flow through the sand to the point where it is being removed it will certainly drag the sand with it. No matter how many times this warning is repeated, the mistake will probably be made many times by some of those who have been cautioned against it, although the blunder, often repeated though it is, causes much loss every year.

JOHN W. ALVORD: About ten years ago, in the construction of the sewerage system of Gary, Ind., very difficult running sand was encountered. The first contractor, using old-fashioned pumping methods of draining the ditches, ran heavily into debt and was greatly delayed in building a large main sewer. Later another contractor accomplished the construction of a similar main sewer about 17 feet deep by the well-point method of draining. The latter ditch was kept so dry by this method that the sand in the bottom of the ditch had about the same consistency as brown sugar. Rapid progress was made and the contractor reaped a good round profit. Since that time the well-point method has become standard in and around Chicago for all very wet or deep running sand ditches.

CLARENCE L. KIRK: Referring to Mr. Alvord's remarks, the speaker has used the well method in building sewers at depths of

18 to 24 feet and found very little difficulty with it. Points were used on both sides of the trench and a header was strung out 3 or 4 feet in length; a rather large pump, say a 10-inch size, was employed.